Research Note

The first confirmed record of the Chinese Pond Mussel (*Sinanodonta woodiana*) (Bivalvia: Unionidae) in the United States

The Chinese Pond Mussel, *Sinanodonta woodiana* (Lea, 1834) (previously referred to as *Anodonta woodiana*), is a widely introduced unionid around the world. There is evidence that *Anodonta* from China were imported into Asian markets in the western United States as early as the late 1800s (Wood, 1892), but were not known to have been released in open waters. Watters (1997) surveyed the countries where this nonindiginous species had been documented as established and reported them from France, Hungary, Romania, Indonesia, Costa Rica, and the Dominican Republic. The native range of this species was reported to be eastern Russia, China, Cambodia [doubtful], Thailand [this is refuted by Brandt (1974)], Malaysia [it is claimed by Brandt (1974) to have been imported to several Malaysian localities by Chinese fish breeders] and Taiwan. Watters (1998, 1999) added Singapore, the Philippines, and possibly Panama to the list of countries where this species has been introduced.

Watters (1997) noted the absence of *Sinaondonta woodiana* records for the United States but pointed out that it might be confused with the native species of *Anodonta* of similar size and shape, *Anodonta suborbiculata* or *Anodonta* sp., subsequently described as *A. hartfieldorum*. Watters observed that "Given the history of this species' invasion elsewhere, and the continued farming and exporting [importing] of its hosts, it is likely that *A. woodiana* eventually will invade North America and other countries."

Information on the range expansion of the Chinese Pond Mussel across Europe has been continuously updated by Mienis (1999, 2001, 2002a–c; 2003, 2004a, b; 2005, 2006a–c; 2007a, b; 2008a, b; 2009a, b; 2010), documenting the occurrence of this invasive mussel as it spread across 15 countries in Europe: Austria, Belgium, Bulgaria, France, Greece, Hungary, Italy, Moldova, Poland, Romania, Serbia, Slovakia, Sweden, the Netherlands, and Ukraine. Distribution information for France and Europe including a discussion of colonization hypotheses and ecological threats has been provided by Adam (2010). Bogan and Schilthuizen (2004) reported it from the island of Borneo, Sabah, Malaysia.

Sinanodonta woodiana appears to have been introduced via the release of host fishes infested with glochidia. Watters (1997) listed potential nonindigenous fish hosts including Cyprinidae (minnows): *Achcilgnathus moriokae*, *Metzia takakii*, *Puntius semifasciolatus*, *Rhodeus tabira*, *Zacco platypus*, *Z. temmincki;* and Gobiidae (gobies): *Rhinogobius brunneus*. Fish hosts also include commercially imported cultured fish: Cyprinidae: Bighead Carp (*Hypophthalmichthys nobilis*), Black Carp (*Mylopharyngodon piceus*), Common Carp (*Cyprinus carpio*), Grass Carp (*Ctenopharyngodon idella*), Silver Carp (*Hypophthalmichthys molitrix*); and Cichlidae (cichlids): Nile Tilapia (*Orcochromis niloticus*). One native fish, Poecillidae, (mosquitofishes), Western Mosquitofish, *Gambusia affinis*, is also reported to serve as a glochidial host. Mienis (2002b) noted that Grass Carp and Silver Carp were the probable host fish for *Sinaondonta woodiana* when it was first introduced into Europe in 1983.

Three live specimens of anodontine bivalves suspected to be *Sinaondonta woodiana* were collected from the New Jersey Conservation Foundation's fish ponds, off Joe Ent Road, 3.3 air miles south-southeast of the center of Pittstown, Franklin Township, Hunterdon County, New Jersey by the NJ Endangered and Nongame Species Program staff on 7 June 2010. These specimens were placed directly into 95% ethyl alcohol and sent to the North Carolina State Museum of Natural Sciences, Raleigh, and catalogued (number NCSM 46965) into the Mollusk Collection.

A small mantle snip was taken to be used for DNA analyses. DNA was extracted and a portion of the mitochondrial gene cytochrome oxidase subunit 1 [COI] was sequenced following protocols outlined in Raley et al. (2006). A BLAST search (Zhang et al, 2000) was performed with these sequences which confirmed their identification as *Sinanodonta woodiana*. These same sequences were inserted into our data matrix of anodontine bivalves where it clustered with two other specimens of *S. woodiana* and was sister to *Anodonta beringiana*. Genetic data and shell characters appear sufficient to verify the identity of these samples as *S. woodiana*, confirming the first record of an established population of this highly invasive species in the U.S.

Following the discovery of *Sinaondonta woodiana*, the New Jersey Conservation Foundation staff lowered water in the ponds and killed all fish with Rotenone. Fish removed from the ponds included: Bluegill, Bighead Carp, Common Carp, Grass Carp (diploid), Largemouth Bass, and American Eel. Although the ponds have been lowered, they are fed by runoff and springs and have begun to refill. It is unknown whether live mussels remain in the ponds. Planning is underway to determine the best method of complete eradication at the site. Possible actions include either draining the ponds via pumping or allowing them to freeze over during the winter and then conducting surveys to determine if there are surviving individuals. Shells have been found in Wickecheoke Creek downstream of the ponds at several locations but no live individuals were found. This creek is

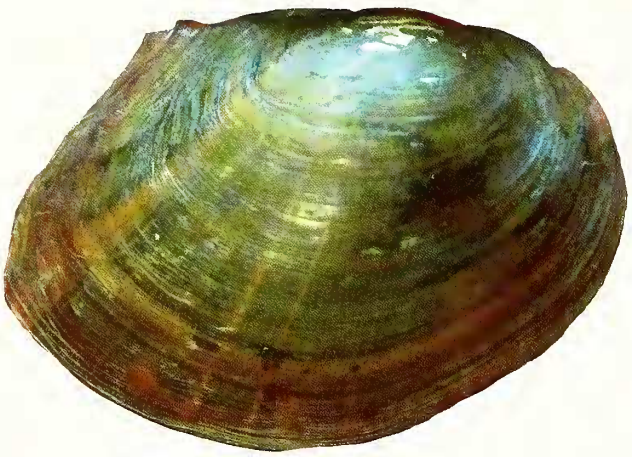

Figure 1. Picture of the shell of one of the specimens collected from fish ponds, Hunterdon County, New Jersey. NCSM 46965-3.

Figure 2. Picture of umbonal sculpture of specimen *Sinanodonta woodiana* NCSM 46965.1.

tributary to Delaware River and also connects to the D & R Canal at Stockton, New Jersey. The occurrence of shells along Wickecheoke Creek and a recent sighting of a relict shell near the D & R canal at Prallsville Mills is evidence that fish bearing Chinese Pond Mussel glochidia may have spread downstream. The extent of the invasion is unclear at this time.

The molecular work presented here is a contribution from the NC State Museum's Molecular Genetics Laboratory.

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